



Travel Model Development & Estimation @ the Atlanta Regional Commission

Presented to:

TMIP Webinar

December 7, 2009

Presented by:

Guy Rousseau

Atlanta Regional Commission



What We'll Cover Today

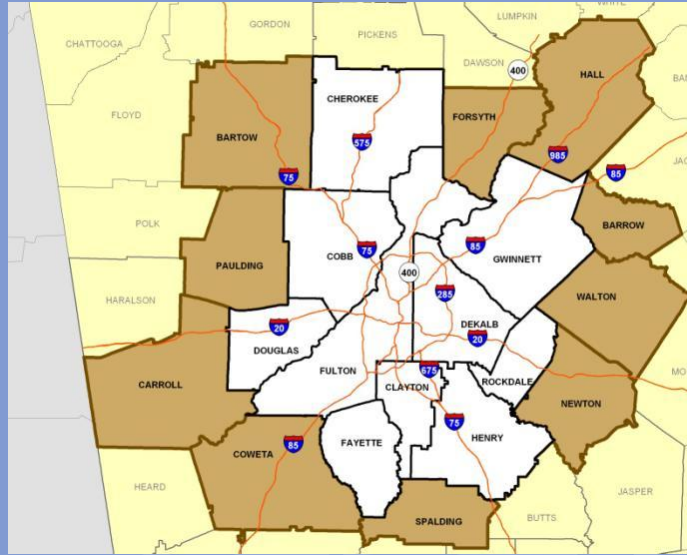
- This is focused on the ARC 4-step trip-based aggregate travel demand model
- We will not cover ARC's new activity-based disaggregate model
- Acknowledgements: PBS&J, PB, AECOM, Bill Allen



ARC
Transportation
Planning

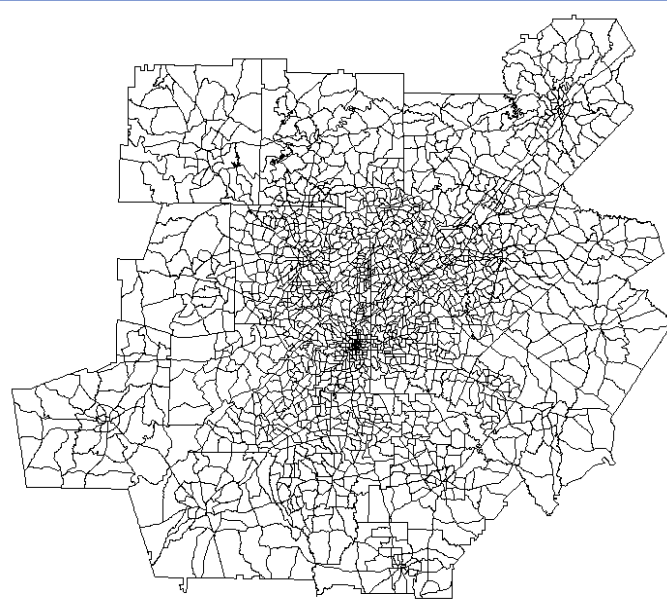
- 20-County Air Quality Non-Attainment Area based on 8-hour ozone standard
- Area for Traffic Forecasting

20-County Non-Attainment Planning Area

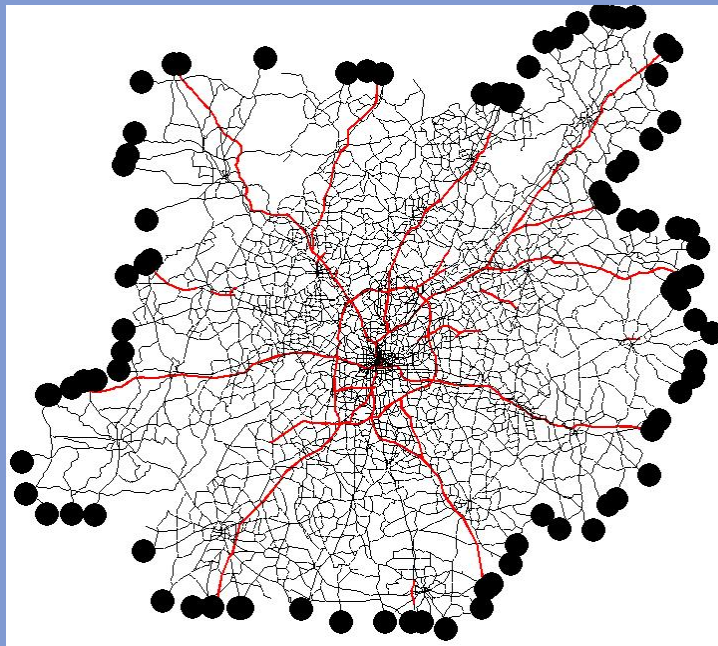


ARC
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Planning

TAZ for the 20-County Region (2024 internal TAZ)



91 External Stations (2024 + 91 = 2115 total taz)



Datasets used for model development & estimation

- Household travel survey: main source for estimating trip generation and distribution
- Trip generation estimates the frequency a person will make trips, by trip purpose, and applies this frequency to individual persons to determine total travel made by residents of the region
- Trip generation was calibrated using a logit structure and used the program "ALOGIT"

Datasets for Estimation

- Trip distribution: gravity model using Census 2000 J-t-W flow data
- Mode choice: used household travel survey and transit on-board survey
- Mode choice: fully-nested logit, calibrated with ALOGIT
- Air passenger model: used air passenger survey, also nested logit in nature

Trip production

- NOT a cross-classification model
- Disaggregate approach using a logit structure estimating the probability of a person making 0 trip, 1 trip, 2 trips, etc...
- Then gets aggregated to TAZ for subsequent models
- Looks at daily trip frequency a person, not a household, makes



Trip production logit model structure, why?

- allows more independent variables to be used
- allows continuous independent variables to be used, rather than only classification variables
- allows statistical measures determining the significance of the independent variables and the entire equation
- Richness of household travel survey



Trip production

- probabilities are used to calculate the effective net trip rate per person, by person type
- Those rates are then used to calculate the overall trip rate for the household, by purpose, and summed to the TAZ level

Trip production

Person-types are:

- adult worker: age 16+, with a full or part-time job
- non-working adult
- child: age 15 or younger

Trip production

The socio-economic independent variables, specified as information for the household, are:

- HH size (1, 2, 3, 4+)
- HH income group (under \$20K, \$20 – 50K, \$50 – 100K, over \$100K)
- Number of workers (0, 1, 2, 3+)
- Number of children (0, 1, 2, 3+)
- Number of autos (0, 1, 2, 3+)



Trip production purposes

home-based work (HBW)
home-based shop (HBShop)
home-based university (HBU)
home-based school (HBSch)
home-based other (HBO)
non-home-based (NHB)



Trip production calibration

- all coefficients had logical signs
- the included variables were logically related to the trip choice
- coefficient values seemed reasonable
- variables had acceptable t-scores (2.0 or higher, as much as possible), indicating a 95+% probability that the coefficient value was indeed different from zero
- achieving the highest feasible rho-squared value, indicating the overall explanatory power of the independent variables



Trip attraction model

Used a workplace establishment survey

Allowed ability to estimate cross-classification attractions models instead of regression models normally developed using household travel survey data

Attraction share model developed



Trip distribution model

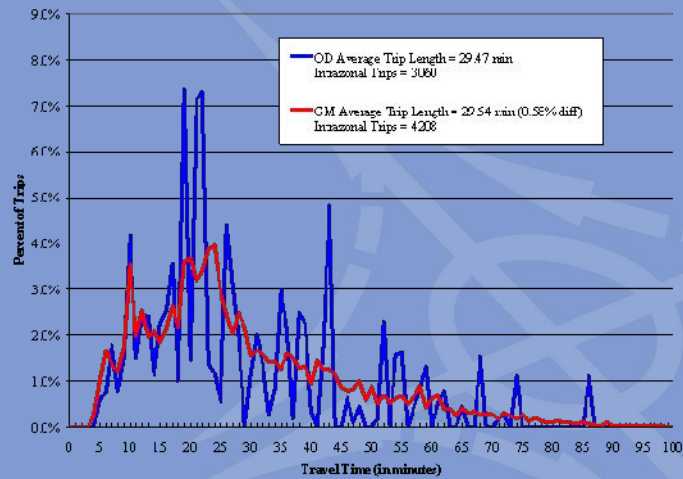
Market segmentation:

- *Zero Car Households*
- *Cars < workers*
- *Cars ≥ workers Incomes 1-2*
- *Cars ≥ workers Incomes 3-4*



Trip Length Frequency Distribution

HBW Zero Cars & Cars < Workers (O-D vs. GM) using Composite Time



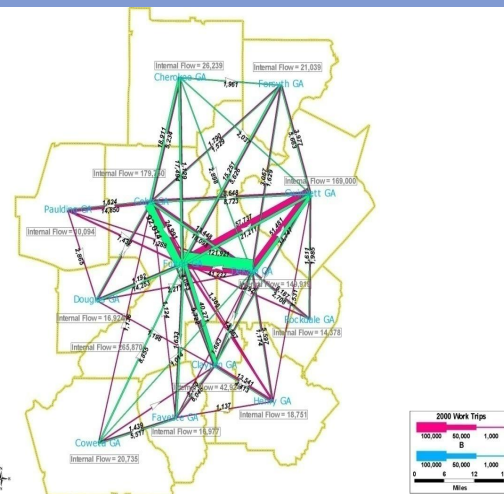
Atlanta Region Work Trip Flows - 2000 CTPP

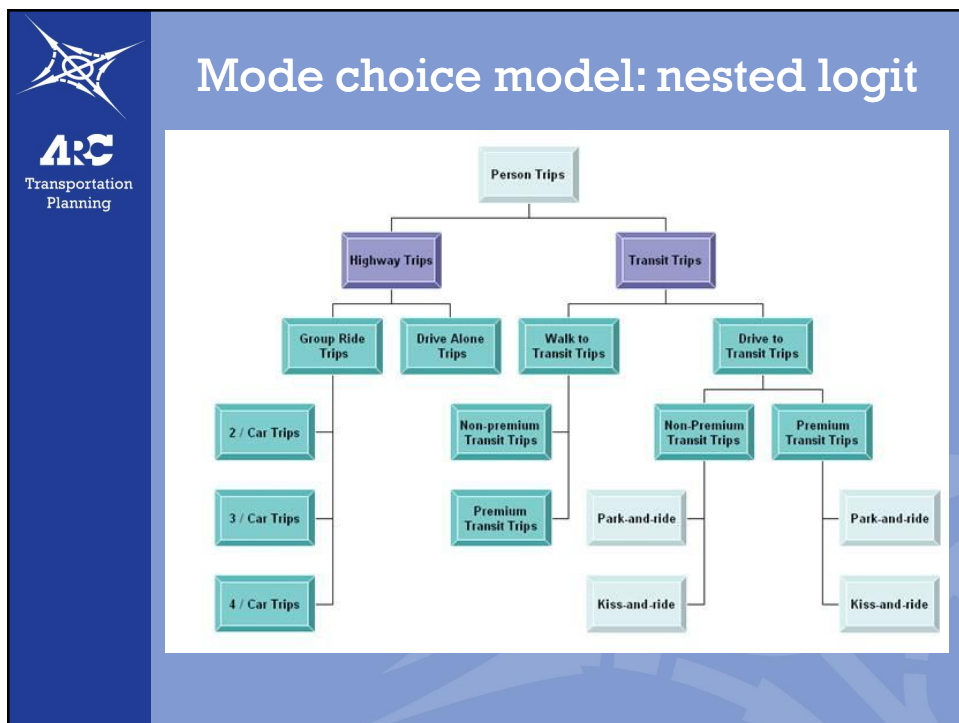
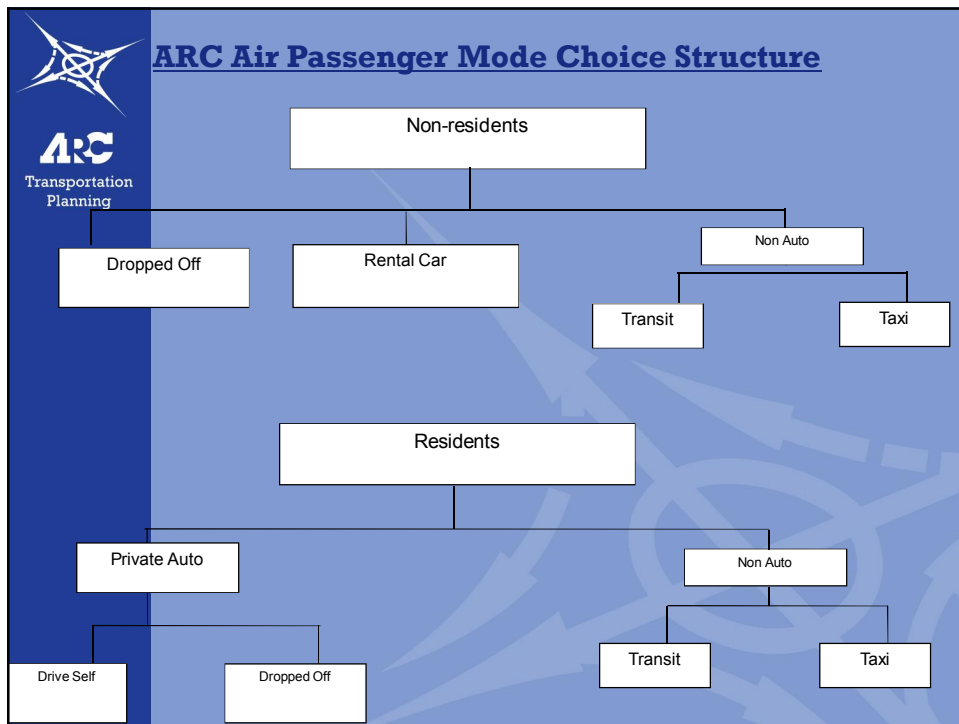
HBW Trips From Cherokee County						
To	2000 Census	2000 Census	OD	2000 Census	OD Survey	
Cherokee	26,239	37.4%	29,610	29.3%	35,417	35.1%
Clayton	257	0.4%	57	0.1%	101	0.2%
Cobb	18,911	26.8%	33,038	32.7%	23,052	22.8%
Coweta	23	0.0%	0	0.0%	0	0.0%
DeKalb	2,898	4.1%	3,400	3.4%	4,900	4.9%
Douglas	174	0.2%	267	0.2%	1,474	1.5%
Elberton	0	0.0%	0	0.0%	0	0.0%
Euclid	1,961	2.8%	3,604	3.6%	4,158	4.1%
Evston	17,454	24.9%	28,343	28.1%	26,722	26.0%
Gwinnett	2,037	2.9%	2,282	2.2%	5,722	5.7%
Henry	37	0.1%	1	0.0%	0	0.0%
Irwin	1,173	1.7%	422	0.4%	0	0.0%
Rockdale	34	0.0%	0	0.0%	0	0.0%
Total	70,223	100.0%	100,985	100.0%	100,995	100.0%

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To	HBW Trips From Fulton County			OD Survey
	2000 Census	GM		
Creskern	1,122	0.3%	26,630	11,281
Clayton	9,722	6.3%	15,838	2.7%
Cobb	24,991	6.7%	45,971	7.8%
Coweta	950	0.3%	1,604	0.3%
DeKalb	41,232	11.0%	77,600	13.3%
Douglas	1,192	0.3%	1,081	0.7%
Evans	1,633	0.3%	2,462	0.4%
Fayette	5,626	1.5%	4,210	0.7%
Forrest	265,670	70.9%	395,578	68.3%
Gwinnett	21,211	5.7%	25,676	4.4%
Henry	954	0.3%	2,419	0.4%
Isabella	178	0.0%	155	0.0%
Jackson	924	0.3%	1,583	0.3%
Total	375,209	100.0%	579,592	100.0%
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Issues & Background

- Spring 2007: Local transit agency Provides Transit Ridership Forecasts to FTA for I-75 Northwest BRT Project
- FTA's Concerns:
 - Transit Ridership Forecasts (High Transit Mode Share in some Regional Travel Pattern)
 - Age & Completeness of Transit On-Board Survey Data Used in Model (Survey Done in 2001), Given High Growth in Region
- FTA's Suggestion: Model Evaluation
- Summer 2007 through 2008: ARC & local planning partners / stakeholders and Consultants Address FTA's Concerns



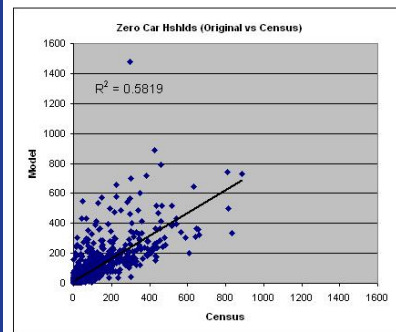
Changes to Atlanta's Regional Travel Demand Model

- Initial Focus: Mode Choice Model
- Findings: Other Model Components Upstream of Mode Choice Need Refinement
- Outcome 1: Improvements Made to Trip Generation, Trip Distribution & Mode Choice
- Outcome 2: Model Recalibrated

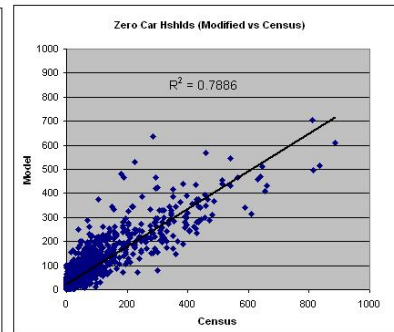
Model development situation

- ARC Release of Updated Model:
January 2009 (Short Term Solution)
- FTA WILL NOT Accept Updated Model forecasts for “New Starts” Funding
- FTA WILL Accept Updated Model forecasts for Transportation Planning & Conformity Determination
- REMINDER: FTA does not approve models, but reviews forecasts
- ARC’s Long Term Strategic Solution:
2009 \$2M Regional Transit On-Board Survey
2010 Model Update

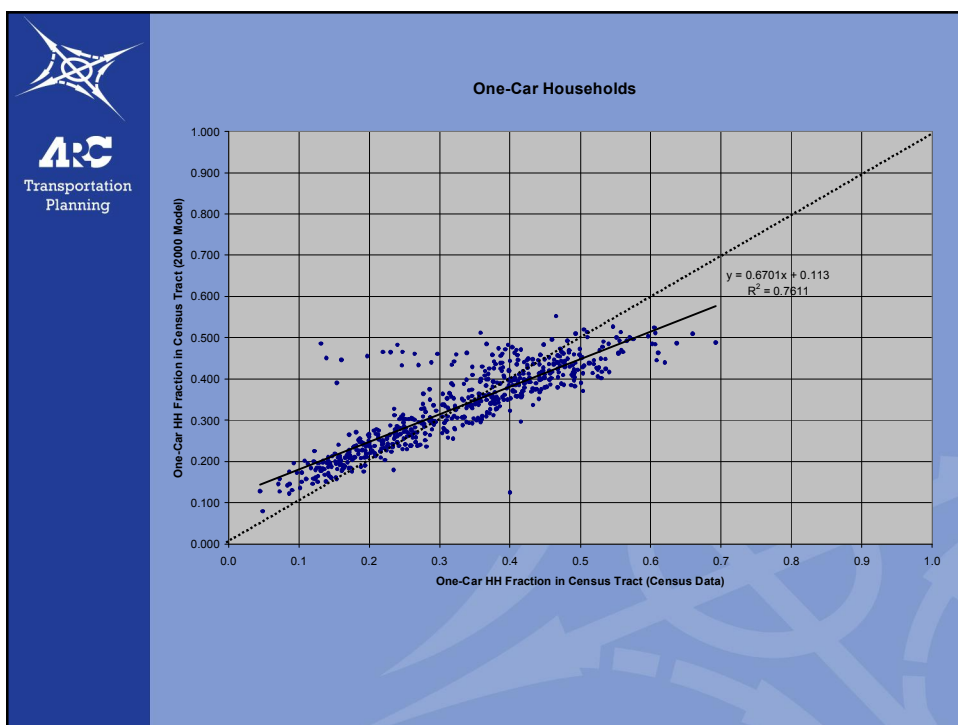
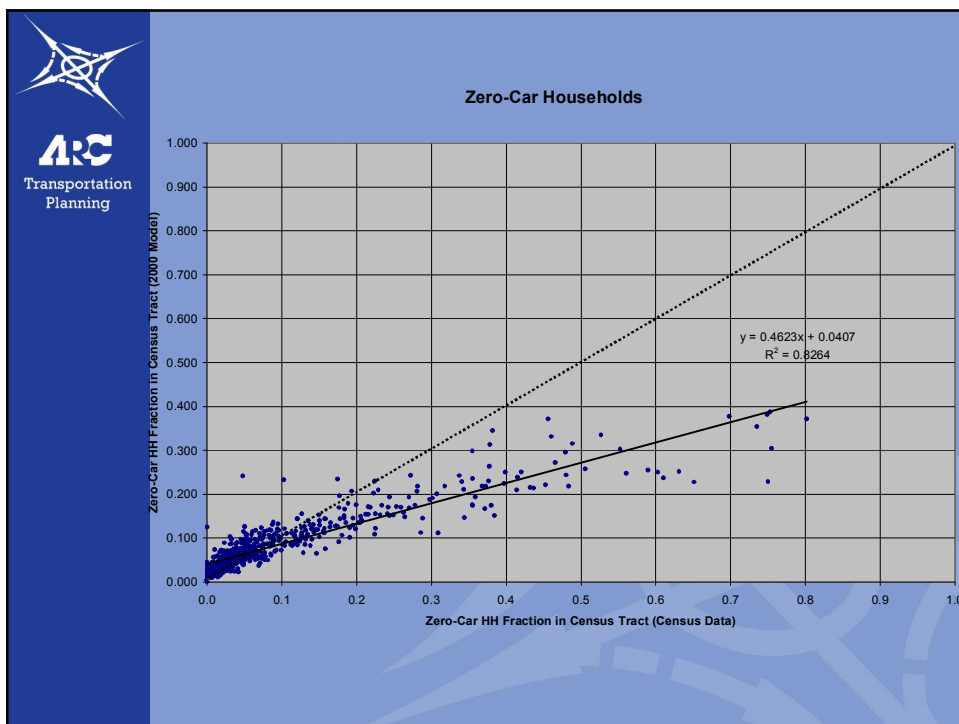
Revised auto ownership model & Zero-Car Households (TAZ Level)



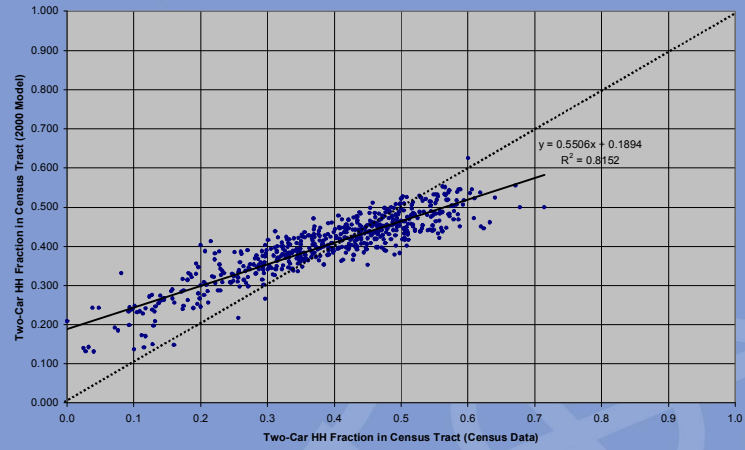
% RMSE = 124%



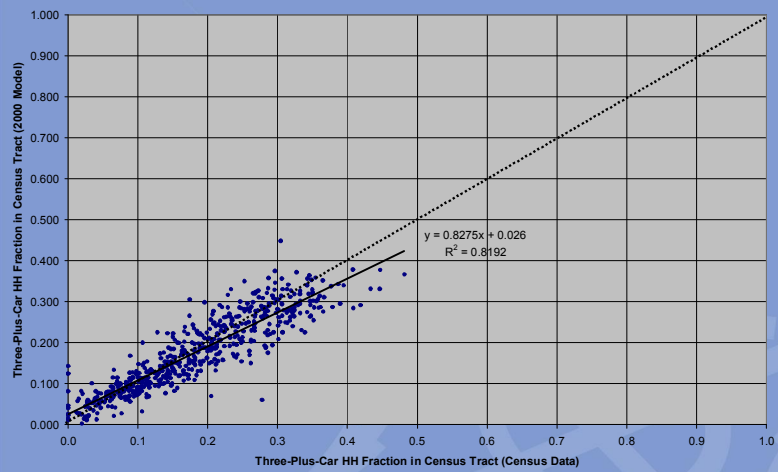
% RMSE = 85%



Two-Car Households



Three-Plus-Car Households



Revised Mode choice model

Revisited HBW, HBNM & NHB models

- ASC & IVT were revised
- BRT: the coefficients were set so that the equivalent IVT fell halfway between express bus and rail.
- The commuter rail coefficients were assumed to be worth 3 minutes of benefit beyond the calibrated rail coefficients.
- Positive numbers in the table reflect a benefit over non-premium transit modes while negative numbers are representative of a disbenefit.

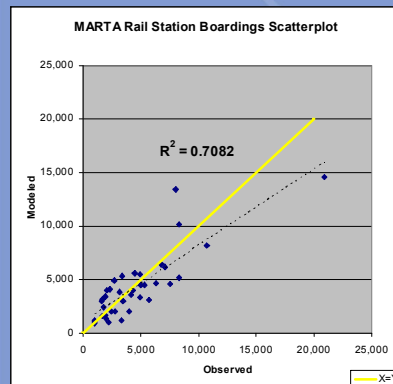
HBW Alternative Specific Constants

Premium Mode Type	Constant	Equivalent In-Vehicle Time (minutes)
Express Bus with Transfer	-0.82834	-33.1
BRT with Transfer	-0.25856	-10.3
Rail with Transfer	0.31123	12.4
Commuter Rail with Transfer	0.38623	15.4
Express Bus No Transfer	0.40000	16.0
BRT No Transfer	0.44074	17.6
Rail No Transfer	0.48148	19.3
Commuter Rail No Transfer	0.55648	22.3

Model Results

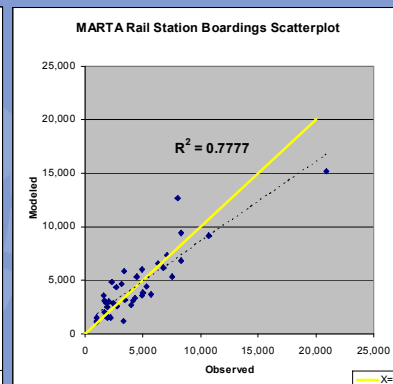
MARTA **Rail** Station Boardings

Original Model



Percent RMSE = 47.2%

Revised Model

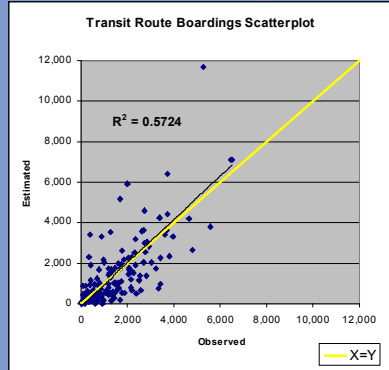


Percent RMSE = 38.8%

Model Results

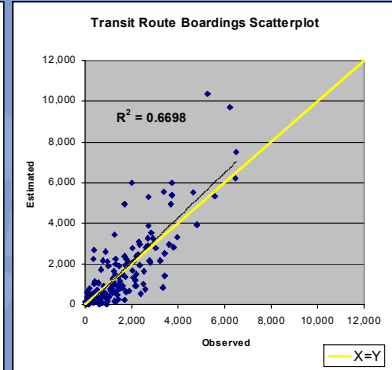
Regional **Bus** Boardings

Original Model



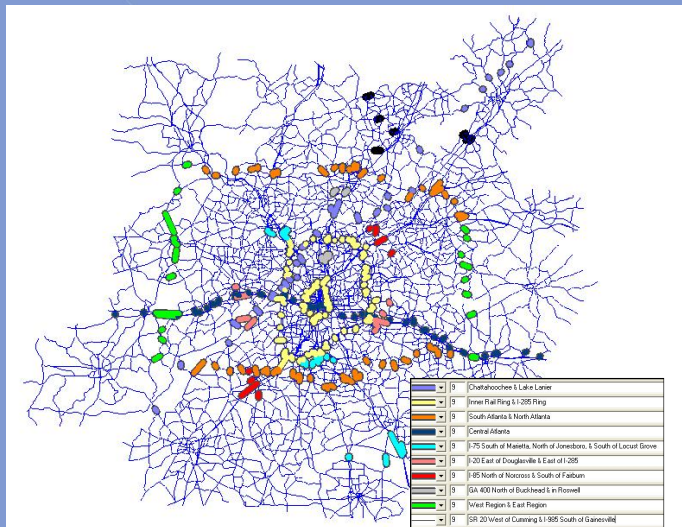
Percent RMSE = 81.2%

Revised Model

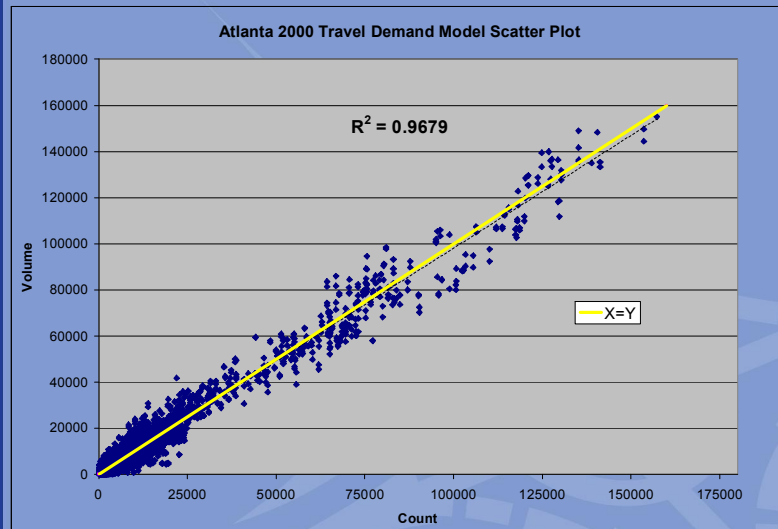


Percent RMSE = 68.2%

Assignment & Screenlines



Assignment results

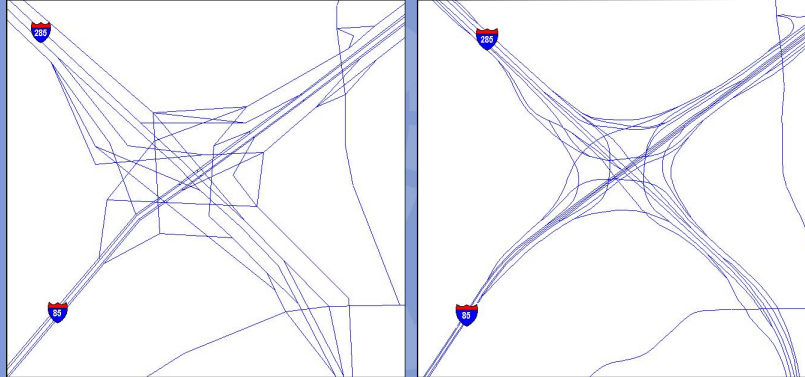


Ongoing Model Enhancements

- Utilize Conflated Networks
- Consolidate Facility Types
- Update Speed/Capacity Tables
- Revise VDF Curves
- Revise Time-Of-Day Factors
- Revise Heavy-Duty External Truck Volumes
- Incorporate Mode Choice Refinements

Conflated Networks

- True Shape Display
- Based on modified NAVTEQ street centerline file
- Modify network with highway shape file



Conclusions & lessons learned

- Model estimation, calibration & validation must rely on latest & greatest planning assumptions and survey datasets available
- Data, data & more data: invest in a strategic plan for data collection, surveys and model development
- Ensure you have ample time to review the data and see what “story” it is telling you
- Coordinate very closely and very regularly with federal agencies, especially FTA, especially if going after New Starts \$\$\$\$\$\$\$\$\$\$



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Questions / Comments

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